
LLNL Lessons Learned LLNL

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Reevaluate Hazards When the Scope of Work Changes

Last October, two Lawrence Livermore National Lab (LLNL) technicians were reviewing the product shipping information on several lecture bottles (pressurized gas cylinders) located in a chemical storage unit. The technicians were preparing the cylinders for shipment back to the vendor, operating under a universal work permit authorizing the general preparation and handling of closed waste containers in the field.

A third worker in the chemical storage unit decided to remove a sidearm flow valve (see Figure 1) from an unrelated small lecture bottle located nearby, which contained 99% deuterium fluoride (DF) gas. The cylinder had been in storage for approximately two years, but appeared to be in excellent condition. The worker determined that the removal of the sidearm valve did not require a work permit, as the work was self-authorized.

As the sidearm was removed, a small wisp of white vapor was emitted from the connection. Although the vapor quickly dissipated, the three workers immediately evacuated the chemical storage unit. A short time later, after observing no further discharge, one of the technicians (wearing nitrile work gloves, a lab coat, and safety glasses) reentered the storage unit and sealed the valve with the cap provided (see Figure 2 below). After it was determined that the DF cylinder was secured and the area was not hazardous, the technicians continued their initial task of preparing the other cylinders for shipment.

A few hours later, the technician who secured the lecture bottle began to feel a slight burning sensation around the lips, but did not report this condition to the supervisor or the Health Services Department (HSD). The following day, the technician continued to feel irritation to the skin around the nose and mouth and reported the condition and the incident to the supervisor. The technician was immediately directed to the HSD for medical evaluation and treatment. HSD staff provided precautionary treatment for the irritation and the technician was released back to work.



Figure 1. Gas bottle storage area prior to the event.



Figure 2. Bottle with cap installed after the event.

Analysis

- The two technicians' authorized scope of work was to prepare a list of cylinder DOT numbers for offsite shipment. The original task did not include replacing cylinder caps, nor was the subject cylinder among the cylinders slated for offsite shipment.
- The individual who removed the sidearm flow valve assembly was not operating under the authorized scope of work. When the scope of work changed for *all workers in the vicinity*, the three workers did not stop to reanalyze the hazards.
- DF is a highly toxic, corrosive gas and is destructive to human tissue. DF exposure can cause respiratory tract burns, skin burns, eye burns, and mucous membrane burns. Pain or irritation can be delayed for several hours, and skin burns that appear to be stable may get worse several hours after exposure if untreated. Treatment includes immediately washing with soap and water and applying calcium gluconate.
- The technician who capped the cylinder noted the label as "deuterium fluoride;" however, DF is chemically equivalent to Hydrogen Fluoride (HF). The technician would have immediately reported to HSD for evaluation if the contents and the hazards associated with the contents had been properly communicated.
- Although the lecture bottle appeared to be in excellent condition and the valve appeared to be closed, this could not be verified without testing or handling. There was no way to evaluate if residual gas was left in the tubing between the sidearm valve and the cylinder shutoff valve. These factors should have prompted a thorough review of the hazards and development of controls.
- The workers were not wearing the appropriate Personal Protective Equipment (PPE) for DF, which would include a full-facepiece respirator with multi-contaminant cartridges, or a half-facepiece respirator with multi-contaminant cartridges and protective eyewear.
- The DF cylinder was not in an approved storage configuration. The LLNL *ES&H Manual* states that valve plugs shall be installed as a final barrier against leakage when cylinders are moved, and that valve protective devices or caps and gas tight valve outlet caps or plugs shall be kept in place when cylinders are stored.

Recommended Action for LLNL Employees

1. Do not handle a material unless you understand the hazards associated with it. Read the container labels when using a material for the first time, or if uncertain about the hazards. Use Material Safety Data Sheets to review the hazards and controls or contact your Safety Team *prior to* handling any new or unknown materials.
2. Stop work and reevaluate the hazards when the scope of work changes. Contact the Responsible Individual and your Safety Team for guidance.
3. Call your Safety Team (or 911 if applicable) when an unexpected event results in a release of material to the environment, or the potential chemical exposure to an individual. Report all unexpected occurrences immediately to your supervisor.
4. Inform other workers of the hazards and controls of chemicals they will be handling. Consider dual labeling with the trade name, technical name, and/or common name for chemicals. While it is not necessary for labels of chemicals used in laboratories to describe the hazards of materials (as is required for the labels of materials used in other workplaces), labels of laboratory chemicals should describe the hazards of the material (e.g., "Deuterium fluoride (hydrogen fluoride) - toxic, corrosive").

5. Exercise caution when working with gas cylinders and regulators. The condition of a gas cylinder, regulator, or valve cannot be assessed based only on appearance.
6. Be vigilant when handling gas cylinders containing or that could contain toxic, corrosive, or reactive gases. Perform operations in a fume hood when possible, and consider the need for additional safety review or the preparation of a safety plan.
7. Wear the appropriate PPE when changing or removing sidearm valves, regulators, manifolds, or other components from a gas cylinder, even though the potential exposure may appear to be very low.
8. Remove gloves and other PPE when finished with the work. It is good laboratory practice to wash hands once gloves are removed. Do not touch exposed areas of the body until gloves are removed.
9. Review the age and status of inactive cylinders containing corrosive gases in your area, and return to the vendor those cylinders that are more than two years old.